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Membrane internal roof gutters

Design trends are seeing an increase in the use of internal gutters, previously seen as risky. With advances in their design and construction, they are now a viable option.

At a glance

- Because of design trends, internal gutters are becoming more popular.
- They have been associated with weathertightness failure.
- E2/AS1 is the associated guidance document.
- Building owners must be made aware that internal gutters need regular maintenance.

Internal gutters or gutters within the roof area – sometimes referred to as box gutters – have historically been associated with weathertightness failure, resulting in significant damage to the building interior and the associated inconvenience and cost of repair for the owner. This has resulted in designers avoiding them in their designs.

Due to changing trends in residential design as well as the availability of high-performance, durable membranes, there has been rise in the inclusion of internal membrane gutters in housing – often associated with low-pitch membrane roofs or other low-pitch roofing systems.

Factors for failure

Factors blamed for the failure of internal roof gutters include:

- inadequate design – insufficient capacity, lack of gutter fall, depth/freeboard and the number of drainage outlets and associated drainage overflows
- poor construction and installation
- incorrect material selection
- blockages to the gutter and drainage systems that restrict drainage and create a build-up of water
- lack of maintenance by building owners.

Because of the failure risk of internal gutters, they must be accurately designed and constructed, and building owners must be made aware of the requirement for them to be regularly checked and maintained.

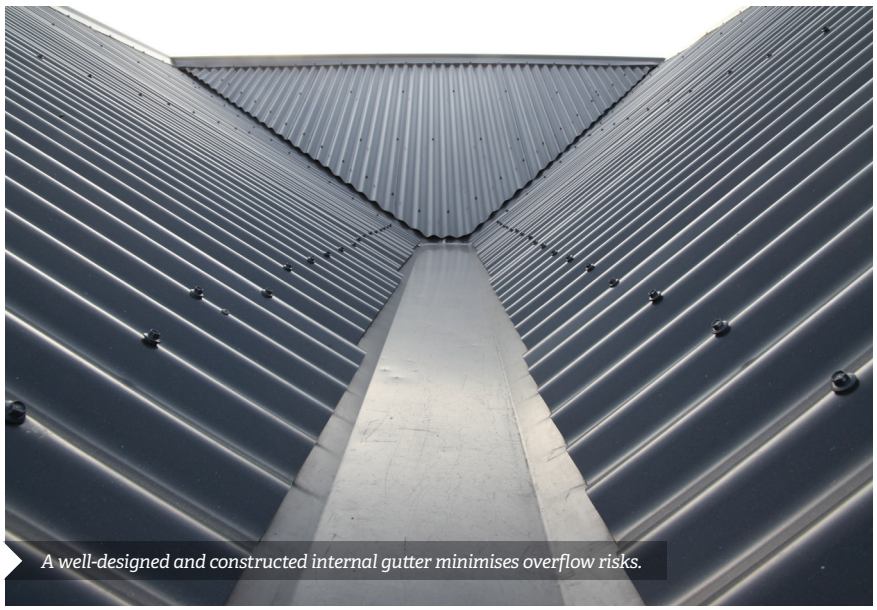
Regardless of the specified roofing material and pitch, membrane internal gutters are a viable roof drainage option and are included in Building Code guidance documents. There is a wide range of suitable membranes available, with most manufacturers and suppliers providing design and installation guidance for both internal roof gutters and associated drainage systems.

Many of the current membranes are pliable and easier to accurately install in more-confined situations often associated with internal gutters. The use of designated membrane installers has also improved the quality of installation.

Refer to E2/AS1

E2/AS1, the guidance document for compliance with Building Code clause E2 *External moisture*, has information on the requirements for internal gutters lined with butyl or EPDM membrane. The use of other membranes suitable for internal gutters is also possible, but these alternatives will require proof of compliance as an Alternative Solution.

E1/AS1 is the guidance document for compliance with clause E1 *Surface water*, covering requirements for membrane internal roof gutters and associated drainage.



A well-designed and constructed internal gutter minimises overflow risks.

Clause B2 *Durability* calls for the membrane to have a specified intended life of not less than 15 years. However, it is sensible to select a membrane that meets the serviceable life of the roof cladding, which could be expected to be greater than this. Selecting a more durable membrane is sensible given that replacement will be relatively difficult in most situations.

Butyl and EPDM membrane internal gutter requirements

While it is non-mandatory to follow Acceptable Solutions as a means of Building Code compliance, both E2/AS1 and E1/AS1 provide good guidance for the design and construction of membrane internal gutters.

E2/AS1 8.1.6.1 sets out specific requirements for membrane internal gutters. They must be constructed with solid substrate gutter boards that facilitate walking on for both construction, membrane installation and ongoing regular maintenance. Construction materials must be compatible with the specified membrane.

The membrane must be installed in one run along the length of the gutter, with no cross-joints in the installation. Butyl or EPDM membrane must be 1.5 mm minimum thickness – 1.0 mm thickness is acceptable for gutters less than 1 m wide.

In no case should the gutter have dimensions of less than a depth of 60 mm minimum and an overall width of 300 mm minimum.

A freeboard depth of 30 mm minimum – over and above the required minimum gutter depth – is required in all situations, with a minimum fall of 1:100 to drainage outlets.

An exception to these requirements is where a membrane internal gutter is incorporated into a membrane roof. In these situations, the minimum gutter depth is 50 mm and there is no requirement for a freeboard allowance.

Where the membrane gutter is installed in roofs formed with non-membrane claddings – for example, profiled metal – the gutter membrane must underflash the roofing material a minimum of 100 mm.

E1/AS1 5.1 sets out specific requirements for the size of internal roof gutters. The internal gutter size needs to be based on dividing the gutter into sections – a section is comprised of the length of gutter between a downpipe or drainage outlet and the high point of the gutter draining to that downpipe/drainage outlet.

Each section of internal gutter needs to have a cross-sectional area not less than that shown in E1/AS1 Figure 16, which provides the area of gutter based on the plan area and pitch of the roof discharging into the section of gutter. The cross-sectional area required is based on a rainfall intensity (I) of 100 mm/hr. Many areas of Aotearoa have a rainfall intensity greater than this – these are shown in E1/AS1 Table A.

Where the intensity for the gutter design under consideration is greater than 100 mm/hr, the required gutter size needs to be calculated by taking the value from Table A and multiplying it by the ratio of I/100.

Internal gutters must drain to downpipes – often via a scupper into a rainwater head or an internal drainage outlet. E1/AS1 Table 5 provides the minimum internal size for round and rectangular downpipes for a given roof pitch and roof plan area served by the downpipe.

All membrane internal gutters require overflow outlets. E1/AS1 5.5.1 calls for overflow outlets that drain to the exterior of the building, with the top of the outlet set at least 50 mm below the top of the gutter. The cross-sectional area of the overflow shall be the same size or greater than the size of the downpipes serving that section of internal gutter.

Drainage outlets and overflows for internal gutters in membrane roofs shall be formed as shown in E2/AS1 Figures 63 and 64.

Membrane internal gutters serving other roofs – for example, profiled metal – must discharge into a rainwater head (which incorporates an overflow) as shown in E2/AS1 Figure 63(a) and (b). Alternatively, they can discharge to an internal outlet as shown in E2/AS1 Figure 64(b) or (c), with overflows provided by another outlet to a rainwater head or an overflow as shown in Figure 63(c) positioned at a height that will not allow water to overflow into the building from the gutter.

Membrane internal gutters design and construction

When an internal gutter incorporated into a long-run metal or tile roof fails or overflows, it is likely that water will enter the building's roof assembly and ultimately the interior. While this is less likely with a membrane gutter that is integral with a roofing membrane, it is still a possibility. Therefore, accurate design and construction is fundamental for effective internal gutter performance.

Key considerations for membrane internal gutter design:

- Design internal gutters that are sufficient to capture and dispose the maximum rainfall intensity that the roof catchment will be exposed to, regarding width, depth and freeboard.
- Eliminate any changes of direction where possible – run the gutter in one straight length. Changes in direction can create construction challenges and restrict water flow.
- Ensure the gutter has effective fall.
- Have sufficient outlets – in the case of one outlet being blocked, another can discharge the full potential catchment.
- Incorporate effective overflow outlets that are located so that overflow water is visible to building occupants (alerting them to potential issues with the gutter).
- Specify a gutter membrane that is fit for purpose.
- Size the gutter to allow easy access for maintenance.
- Ensure the gutter is constructed to eliminate potential in-service deflection or structural movement.

What to consider

To ensure internal membrane gutters collect and drain water as effectively as possible, it is better to be more conservative with design and construction:

- Design to a rainfall intensity of not less than 200 mm/hr.
- Ensure the gutter has sufficient freeboard capacity to prevent overflowing due to wave action occurring in windy situations. This can occur when the water level in the gutter is above 50 mm below the top of the gutter.
- Take the sides of the gutter well above the height of the drainage outlet or overflow. If the outlet/overflow is blocked – not just through lack of maintenance but due to hail or snow – water could overflow into the roof space with non-membrane roofs.
- Construct the gutter wider than the 300 mm minimum required – this will not only increase flow capacity but also allow for easier viewing and access for maintenance. It can also facilitate easier repair where required.
- Increase the number of drainage outlets beyond requirements.
- Incorporate snow guards in snow-prone locations – snow accumulation will block water flow.
- Ensure downpipes and/or spreaders from above do not discharge directly into an internal gutter.
- Incorporate drainage outlets at no more than 12 m centres – this will provide a maximum gutter run of no more than 6 m.
- Incorporate dome-type leaf guards to internal drainage outlets.
- Increase the gutter fall beyond the required 1:100 minimum. A 1:60 fall will provide better drainage, ensuring all water is removed more effectively, and will allow for any potential inaccuracy in construction or deflection in the gutter over time, meaning that drainage will not be compromised.
- Locate overflow outlets where overflow will be easily visible.
- Ensure the gutter construction is solid enough to eliminate deflection/sagging over the life of the building.

Maintenance is crucial

Once the internal membrane gutter installation is complete, it should be flood tested to ensure that it drains effectively and that there are no leaks. Any internal downpipes associated with the gutter must also be pressure tested prior to enclosure.

As internal gutters have a higher risk of failure because of lack of maintenance, building owners need to be made aware of the need for regular inspections of both the gutter and drainage systems and the removal of any accumulated debris. Inspection for any potential degradation of the membrane is also important.

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